



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> : <b>C11D 1/66, 1/825, 1/83, 3/37</b>		<b>A1</b>	(11) International Publication Number: <b>WO 00/58428</b>
			(43) International Publication Date: 5 October 2000 (05.10.00)
(21) International Application Number: <b>PCT/US00/08257</b>		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 28 March 2000 (28.03.00)		<b>Published</b> <i>With international search report.</i>	
(30) Priority Data: 60/126,726 29 March 1999 (29.03.99) US			
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(54) Title: HEAT-ACTIVATED CLEANING COMPOSITIONS WITH WRINKLE-RESISTANCE AND METHODS OF USE			
(57) Abstract			
<p>The present invention relates to self-thickening, heat-activated cleaning compositions that comprise a self-thickening surfactant system selected from among nonionic surfactants, a surfactant blend comprising an amphoteric surfactant optionally in combination with one or more anionic surfactants, or a combination of any of the foregoing. More specifically, the self-thickening heat-activated cleaning compositions of the present invention permit convenient use by the consumer in such non-commercial environments as home- or laundromat style clothes dryers, without attendant difficulties such as unsightly residue on the treated garments, unacceptable seepage or leaching of the product during application and handling at ambient temperatures, etc., and avoids the need for extraneous or non-cleaning, non-performance enhancing thickeners or gelling agents. Also included in the present invention is the optional use of higher ethylene oxide-containing alcohol ethoxylates which tend to impart a wrinkle resistance to treated articles.</p>			

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Title: **HEAT-ACTIVATED CLEANING COMPOSITIONS  
WITH WRINKLE-RESISTANCE  
AND METHODS OF USE**

**BACKGROUND OF THE INVENTION****1. Field of the Invention**

The present invention relates to compositions that are useful for dry-cleaning of textiles and garments. More specifically, the self-thickening heat-activated cleaning compositions of the present invention permit convenient use by the consumer in such non-commercial environments as home- or laundromat style clothes dryers, without attendant difficulties such as unsightly residue on the treated garments, unacceptable seepage or leaching of the product during application and handling at ambient temperatures, etc., and avoids the need for extraneous or non-cleaning, non-performance enhancing thickeners or gelling agents.

**2. Brief Statement of the Related Art**

So-called home dry-cleaning kits which freshen and/or spot-clean stained fabrics have been described in the prior art and commercial products are appearing with increasing frequency in the consumer market. The use of such products is targeted to reduce the number of visits a consumer must make to commercial dry-cleaning establishments in those instances where garments may be only lightly soiled or malodorous.

For instance, one method for dry-cleaning fabrics in a laundry dryer is disclosed by Leigh, *et al.*, in EP 0 429 172 A1. Leigh involves the placing of fabrics into a flexible container, such as a bag, along with one or more flexible treated substrate articles. The

fabrics and treated substrate article are then tumbled together inside the flexible container in a laundry dryer, after which the container is opened and the fabrics are removed. The flexible substrate articles are preferably treated by impregnation with one or more non-aqueous solvents selected from the group of terpenes, pinenes, volatile silicones, and mixtures thereof. The invention does not mention the desire to partially inhibit the release of cleaning actives from the substrate article, in order, for example, to improve handleability during use, nor does it mention which actives are ideally released slowly over an extended period in the laundry dryer.

Another method for treating fabrics in a laundry dryer is disclosed by Smith, *et al.*, in U.S. Pat. No. 5,238,587. Smith discloses a fabric cleaning article for use with a home dry-cleaning kit comprising a porous substrate sheet impregnated with a gelled cleaning composition. The gelled cleaning composition consists of water, a gelling agent, an organic solvent, and a surfactant. Suitable substances for the gelling agent include starches, modified celluloses, fatty acid salts and polysaccharide gums. While Smith, *et al.*, apparently recognize the fact that there are advantages to be obtained by thickening the cleaning compositions, the specific need for gelling agents necessarily introduces complications to the manufacturing process, such as requiring pre-dispersion of the gelling agents, added expense due to the need for one or more metal cations and/or preservatives, etc. Moreover, often the result obtained involves typical consumer-perceived drawbacks such as product residues on garments, unsightly residual compositions on the substrate sheet, etc. Furthermore, an additional disadvantage of Smith, *et al.*, is the expense of the gelling substances, which take no active part and thus contribute nothing in terms of the efficacy of the cleaning process itself.

Yet another home dry-cleaning composition intended for use in contacting garments in conjunction with domestic clothes dryers is disclosed by Sidoti, *et al.*, U.S. Pat. No. 5,865,851. The compositions of Sidoti, *et al.*, comprise water, a nonionic surfactant, an anionic surfactant selected from among sulfosuccinates and sulfosuccinamates as well as salt forms thereof; and an organic solvent. Thickeners and gelling agents are mentioned as possible adjuvants. One disadvantage of the Sidoti formulations is that the cleaning

compositions require two different surfactants in addition to an organic solvent.

Furthermore, the notion of a formulation that provides effective cleaning while featuring substantial thickening at levels of 92.5% water seems doubtful.

5 Yet further compositions for treating of garments in home dry cleaning processes are taught by Siklosi, *et al.*, in U.S. Pat. No. 5,547,476 and U.S. Pat. No. 5,632,780. In both the '476 and '780 patents, Siklosi, *et al.*, teach cleaning compositions comprised primarily of water and at least two solvents. In neither patent is a deterative surfactant mandatory, and the compositions exemplified therein do not contain surfactant levels above 2.5 weight %. In  
10 passing, it is also noted that the compositions of '780 patent further comprise a polyacrylate-based emulsifier, although it is not taught whether the polyacrylate imparts thickening qualities to the formulations. Nor does it teach whether the polyacrylate-based emulsifier serves any cleaning or refreshing function.

15 Finally, alternate compositions for the treatment of garments in home dry-cleaning processes are taught by Roetker in U.S. Pat. No. 5,591,236 and U.S. Pat. No. 5,630,847, in which cleaning is effected through use of an article having a cleaning composition comprising water, at least one propoxylated propanol solvent and a polyacrylate emulsifier. Neither patent requires the presence of a surfactant, although a deterative surfactant is an  
20 optional component for the '236 patent. Where a surfactant is included in the examples of the '236 patent, surfactant levels never exceed 2.5 weight %. It is unclear whether any thickening is obtained in the compositions. Nor does it teach whether the polyacrylate-based emulsifier serves any cleaning or refreshing function.

25 One disadvantage of several of the prior art references is the additional manufacturing complexities and costs associated with the use of thickeners and/or gelling agents that contribute nothing to the cleaning or refreshing efficacy of the formulations. An additional disadvantage of many of the prior art compositions is the fact that residual powders or particles may be left behind on or entrained in the articles or garments with which they have  
30 been contacted. Finally, another disadvantage of the prior art dry-cleaning compositions discussed above, as will be apparent to those skilled in the relevant art, is that at least one

solvent is required in each of the cited formulations.

### SUMMARY OF THE INVENTION AND OBJECTS

None of the prior art references teach the use of a thickened cleaning composition for non-commercial dry-cleaning or fabric refreshing purposes that obviates the need for extraneous thickeners or gelling agents. In addition, none of the prior art techniques for non-commercial dry-cleaning feature compositions that leave no visible residues either in or on the surface of the articles being refreshed and/or cleaned. Still further, none of the prior art dry-cleaning compositions provides a substance that is relatively thick at ambient temperatures, yet one that is capable of heat-thinning for facile release, flow characteristics and activation at slightly elevated temperatures. Finally, none of the prior art compositions that are intended for the non-commercial dry-cleaning or treatment of articles offer a cleaning or fabric refreshing composition that is essentially free of organic solvents. It is therefore noted that use of the term solvent herein is intended to refer to non-aqueous fluids which are organic in character.

It is therefore an object of the present invention to provide a self-thickening, heat-activated composition for the non-commercial dry-cleaning of articles.

It is also an object of the present invention to provide a technique for non-commercial dry-cleaning that avoids the need for extraneous or non-cleaning, non-performance enhancing thickeners or gelling agents.

It is a further object of the present invention to provide a composition for the non-commercial dry-cleaning of articles, which composition leaves behind no residues or build-up of materials either in or on the surface of the articles being refreshed and/or cleaned.

It is a still further object of the present invention to provide a self-thickening composition for non-commercial dry-cleaning, which composition is viscous at ambient temperatures.

It is still a further object of the present invention to provide a self-thickening composition for non-commercial dry-cleaning that is viscous at ambient temperatures and furthermore is capable of exhibiting reduced viscosity at slightly elevated temperatures.

It is yet a still further object of the present invention to provide a technique for the non-commercial dry-cleaning and/or refreshing of articles that involves the use of a composition that exhibits thickened characteristics at ambient temperatures and is additionally capable of heat thinning at slightly elevated temperatures to provide facile release, improved flow characteristics, and overall better cleaning efficacy.

### **DETAILED DESCRIPTION OF THE INVENTION**

Unless specifically indicated otherwise, all amounts given in the text and the examples which follow are understood to be modified by the term "about," and those figures expressed in terms of percent (%) are understood to refer to weight percent, unless indicated otherwise.

The present invention relates to heat-activated cleaning compositions and methods for the removal of stains, soils and malodors from fabrics and/or related garments. The heat-activated cleaning compositions of the present invention comprise thickened surfactant systems which can be easily applied to substrate articles or introduced directly to garments for cleaning without undue manufacturing complexities. The cleaning compositions are sufficiently viscous or solid under ambient temperatures so as to minimize the amount of undesirable and extraneous material that might end up on the hands of the consumer during either spot pre-treatment of the garment or, where desired, during introduction of the substrate article into a closable home dry cleaning bag before placement into the rotary dryer as described further hereinbelow. The thickened cleaning compositions exhibit viscosities of greater than about 500 centipoise (cP or milli-Pascal-sec, mPas•s), preferably greater than about 1,000 cP (mPas•s), and most preferably greater than about 2,000 cP (mPas•s).

The present invention anticipates the use of cleaning compositions in conjunction with some type of warming or heat source, or a home heat-generating device. By way of

example, it is contemplated that the self-thickening heat-activated compositions of the present invention will typically and most generally be employed in conjunction with the use of a rotary clothes-type dryer. However, it is entirely possible that the self-thickening compositions of the present invention could also be utilized in conjunction with such devices as a hot air gun, hair blower, heat fan and even a microwave oven or other microwave-generation device; as well as any other heat source. In a typical use situation, the garment or garments to be freshened or cleaned are treated before or contemporaneously with placement in, on or near the heat-generating device. Although the following discussions will be mainly directed towards use of a home rotary dryer, it will be understood by those knowledgeable in the relevant area that any of the above-mentioned or any subsequently developed home heating sources may be appropriate for use with the heat-activated cleaning compositions of the present invention as discussed more fully herein.

According to one embodiment, the heat-activated cleaning and fabric refreshing compositions of the present invention comprise:

a self-thickening surfactant system selected from among:

a) at least one nonionic surfactant;

b) a surfactant blend further comprising an amphoteric surfactant optionally combined with one or more anionic surfactants; and

c) combinations of any of the foregoing; and optionally, water;

wherein the self-thickening surfactant systems are solid or highly viscous at room temperature.

According to an alternate embodiment of the present invention, the novel heat-activated cleaning and fabric refreshing compositions of the present invention comprise:

at least one self-thickening surfactant system;

optionally, water; and

optionally, bleaching agents, brighteners or fluorescent whitening agents, fragrances, chelating agents, sequestrants, enzymes, thickeners, dye transfer inhibitors, fabric softeners, antistatic agents, antiredeposition agents, soil release agents, anti-wrinkle agents,



antimicrobial agents, pesticides such as acaricides, sizing and shrinkage control agents, etc.

In one technique according to the present invention, the novel heat-activated cleaning and refreshing compositions are incorporated into a substrate article that is used as a carrier for the inventive compositions. An item to be freshened or cleaned is then treated with the cleaning composition for subsequent placement in a rotary dryer or exposure to a heat source as defined above, or the item may be simultaneously introduced into a rotary dryer along with the substrate article containing the composition. In such instances where no substrate article is used to deliver the heat-activated cleaning composition to the garment or item being cleaned, the cleaning composition may be applied directly to the item through a conventional dispenser such as a spray bottle, squeeze bottle, aerosol, sponge, roller or other container. Yet other means for incorporation of the self-thickening cleaning composition of the present invention will be discussed more fully below.

In an alternate embodiment, a technique for the use of the heat-activated cleaning and refreshing compositions according to the present invention comprises the use of:

- a self-thickening surfactant system;
- a flexible container; and
- a substrate article.

As will be understood by those knowledgeable in the relevant art, it may also be possible to combine the flexible container and substrate article components of the above execution together in one article. According to an alternate embodiment of the invention, therefor, an alternate technique for the use of the self-thickening heat-activated cleaning or refreshing compositions of the present invention comprises the use of:

- a self-thickening heat-activated cleaning composition further comprising:
- at least one surfactant system; and
- a flexible container

where the flexible container is suitable for delivering the cleaning composition to the garments or items to be dry-cleaned or freshened, and the surfactant system is selected from among the nonionic surfactant, surfactant blend (i.e., the amphoteric surfactant optionally

combined with one or more anionic surfactants described above); as well as any combination of the foregoing.

Regardless of the technique used to introduce the heat-activated cleaning compositions of the present invention to the target item or garment, the cleaning efficiency of the compositions relies on intimate contact between the garment(s) and the composition during heating to remove stains, soils and malodors. Where the novel heat-activated cleaning compositions of the present invention are introduced to garments or items to be cleaned via an intermediary device such as a substrate or carrier article, cleaning is achieved through random tumbling action in the dryer in order to assure intimate contact between the cleaning or refreshing composition and the substrate article. Typically, but not always, where the heat-activated cleaning compositions are delivered up to the items being cleaned via a substrate article, it is contemplated that some type of flexible container or bag may be used to contain the substrate article and item(s) to be cleaned. A number of flexible containers suitable for use with non-commercial dry-cleaning are known in the prior art, examples of which may be found in U.S. Pat. No. 762,648 to Yeazell; U.S. Pat. NO. 5,789,368 to You, *et al.*, U.S. Pat. No. 5,681,355 to Davis, *et al.*, and PCT application No. WO 96/30,480 to Siklosi, *et al.*

The substrate article is either a closable bag, to which the composition has been directly applied or, as is more typically the case, an independent article to which the heat-activated cleaning composition is applied for subsequent addition to the flexible bag along with the garments to be freshened or cleaned. In the preferred embodiment, the substrate material is a flexible nonwoven fabric or foam, which is able to withstand exposure to chemicals and/or heat during storage and during the drying cycle. A number of materials are suitable for use as the substrate article, as may be found described in: U.S. Pat. No. 5,300,238 to Lin, *et al.*; U.S. Pat. No 5,840,675 to Yeazell; U.S. Pat. No. 5,804,548 to Davis; U.S. Pat. No. 5,630,848 to Young, *et al.*, and PCT application WO 98/58,114 to Reed.

The closeable bag is flexible, is of sufficient volume to contain one or more garments, and is composed of a material that can withstand exposure to chemicals and/or heat during

the drying cycle. It is preferred that the closable bag allows for partial venting of the water that originates, at least in part, from the surfactant systems, optional water and other vapors. It is further preferred that the bag is able to retain some vapors, so that it partially inflates and allows the garments to more freely tumble within. It is especially preferred that the bag has sufficient venting capability to maintain a slight positive pressure with some venting to allow a portion of water vapor which may be present to escape and promote at least partial drying of the garments.

In an alternate embodiment, the self-thickening, heat-activated cleaning compositions of the present invention may be incorporated together with the components of a home dry-cleaning kit, such as may comprise the following:

- a self-thickening heat-activated cleaning composition further comprising:
  - at least one surfactant system;
  - a flexible container;
  - 15 a substrate article;
  - optionally, at least one pre-spotting solution; and
  - optionally, an absorbent pad.

In the foregoing embodiment, the purpose for the absorbent pad is to absorb soils, grime, etc., following use of the pre-spotting solution, as well as any excess cleaning composition, i.e., surfactant(s) and any solvents that may be present. Alternately, as will be apparent to those knowledgeable in the area, where the self-thickening heat-activated cleaning compositions are incorporated directly into the flexible container, obviating the need for a separate substrate article, a home dry-cleaning kit according to the present invention may comprise:

- a self-thickening heat-activated cleaning composition further comprising:
  - at least one surfactant system;
  - a flexible container;
  - optionally, at least one pre-spotting solution; and
  - 30 optionally, an absorbent pad.

SURFACTANT SYSTEMS

The self-thickening heat-activated cleaning compositions of the present invention are composed of single or multiple surfactants, which possess the ability to spontaneously gel, thicken, or solidify at ambient temperatures without the need for additional thickeners, dispersants or gelling agents. The surfactants are judiciously chosen such that under temperatures experienced in a rotary dryer, for example, the compositions undergo one or more spontaneous phase transitions to a more fluid state, whereby they can effect removal of stains, soils, and malodors. In their self-thickened state at ambient temperatures, the cleaning systems of the present invention exhibit viscosities that are generally above about 500 centipoise (cP; or milli-Pascal-sec, mPas•s), preferably above about 1,000 cP (mPas•s), and most preferably above about 2,000 cP (mPas•s).

By judicious choice of such surfactants, it surprisingly has been found that a balance can be achieved between multiple criteria. For example, one can achieve facile application of the cleaning composition under common manufacturing procedures, and yet not unduly expose the consumer to undesirable extraneous matter from getting onto their hands either during spot treatment of the garment, or during introduction of the substrate article into the closable home dry cleaning bag or flexible container before introduction to a heat source or placement into a rotary dryer. Moreover, excellent general cleaning or refreshing of garments can be achieved without undesirable residues which is known to occur with use of some superfluous thickeners and gelling agents. It appears that the need to simultaneously satisfy all of the above criteria, or the application of such compositions as claimed herein to satisfy all of the above criteria has not been recognized by former home dry-cleaning products.

Surfactant systems which have minimal fluidity at ambient temperatures yet undergo one or more phase transitions at elevated temperatures have long been recognized in the academic literature. Most of these have *not* been used in typical household cleaning compositions of the prior art, however, owing to the attendant difficulties in solubilizing or combining them at ambient temperature. They tend to be either too viscous or are solid at room temperature, or require the use of organic solvents for processing or formulation into

final products. It is precisely the fact that some of these surfactants *are* minimally fluid at ambient temperatures, however, that causes these—i.e., those surfactants that are highly viscous or solids and that have phase transition temperatures slightly *above* ambient temperatures—to be desirable for use in the surfactant systems of the present invention. This is because they can be readily handled without seepage or leaking at ambient temperatures and/or provide acceptable tactile impression (hand feel) under use conditions; yet they readily flow at slightly elevated temperatures, such as those brought about by an appropriate heat source as described above. By way of example, note that certain alcohol ethoxylates (nonionic surfactants) are known to be solid at room temperature, yet undergo one or more phase transitions at elevated temperatures. Such alcohol ethoxylates are suitable for use with the surfactant systems of the present invention as discussed hereinbelow. For further information on nonionic surfactants, see M. Rösch, *Configuration of the Polyoxyethylene Chain in Bulk*, Chapter 22, in Schick, Martin J., "NONIONIC SURFACTANTS," Marcel Dekker, Inc., New York (1967), pp. 753-793, and J. Sjöblom, P. Stenius and I. Danielsson, *Phase Equilibria of Nonionic Surfactants and the Formation of Microemulsions*, Chapter 7, in Schick, Martin J., "NONIONIC SURFACTANTS Physical Chemistry," Marcel Dekker, Inc., New York (1987), pp. 369-434, both of which are incorporated by reference herein.

Certain other surfactants—including, but not limited to other alcohol ethoxylates with lower pour points than those stated above—may combine with supplemental quantities of water to give rise to self-thickening surfactant systems. This "supplemental" water is understood to refer to water in addition to any which may be inherently present with the surfactant as originally manufactured. The self-thickening surfactant systems are essentially non-flowable at ambient temperatures, yet they undergo one or more phase transitions that allow them to flow readily at elevated temperatures. Such systems can include thickened compositions characterized as liquid crystals, elongated micelles, and the like. However, the advantage of using such surfactant systems as those claimed herein for home dry cleaning and refreshing applications to solve all of the above criteria is clearly not obvious, as witnessed by prior inventions that require and claim the use of additional thickeners, dispersants, or gelling agents.

Certain nonionic surfactants, either singularly or in combination, can spontaneously form thickened or gel phases when mixed with water. Exemplary nonionic surfactants include linear ethoxylated alcohols, such as those sold by Shell Chemical Company under the brand name Neodol®. Other commonly available suitable nonionic surfactants can include other linear ethoxylated alcohols with an average chain length of 6 to 18 carbon atoms (C6-18) and averaging about 2 to 20 moles of ethylene oxide (2-20 EO) per mole of alcohol; linear and branched, primary and secondary ethoxylated, propoxylated alcohols with an average length of about 6 to 18 carbon atoms and averaging 0-10 moles of ethylene oxide and about 1 to 10 moles of propylene oxide per mole of alcohol; linear and branched alkylphenoxy (polyethoxy) alcohols, otherwise known as ethoxylated alkylphenols, with an average chain length of 8 to 18 carbon atoms and averaging 1.5 to 30 moles of ethylene oxide per mole of alcohol; as well as mixtures of any of the foregoing.

Surprisingly, it has also been found that the use of nonionic surfactants with much higher EO content than heretofore traditionally available can provide a significant advantage. The benefit that has been observed is that certain fabrics that have been heat treated with higher EO-containing nonionic surfactants tend to *not* wrinkle as readily as they might previously have, had they not been so treated. Furthermore, under conditions of higher relative humidity, the extent of wrinkling can even perceptibly *decrease*. In other words, the exposure of certain fabric articles to high EO-containing alcohol ethoxylate surfactants tends to impart a wrinkle resistance to the treated articles that may, in some instances, even improve over time. The amount of nonionic surfactant that may be used in accordance with the teaching of the present invention is greater than about 10% of the total self-thickening surfactant system. That is, there may be about 10-100% nonionic surfactant present in the heat-activated cleaning compositions of the present invention.

The ethoxylated alcohol surfactants that have most successfully imparted wrinkle resistance to fabrics upon heat treatment include that contain above about 30 moles of EO per mole of alcohol, preferably above 50 moles of EO per mole of alcohol, and most preferably above about 70 moles of EO per mole of alcohol. In general, the greater the EO-content of the ethoxylated alcohol, the greater the ability of the alcohol to impart wrinkle resistance to a

fabric. It is anticipated, however, that if the EO-containing surfactants are too large, i.e., have too large a hydrophobic backbone and have too high an EO content per mole of alcohol, the phase transition temperature of the resulting cleaning composition may be too high for the particular heat source to conveniently cause the gelled or thickened composition to flow. Thus, there is likely a practical upper limit as to the molecular weight and number of EO groups suitable for a given ethoxylated alcohol surfactant to impart wrinkle-resistance qualities to a treated fabric or garment. Exactly what the maximum number of EO groups is, however, will depend to large extent on the particular heat source used.

Among the various fabrics that were tested for evaluation of wrinkle resistance, it was found that cotton and certain cotton blends evidenced the greatest wrinkle resistance when treated with the inventive cleaning compositions comprising high EO-containing surfactant systems. Without being bound by theory, Applicants speculate that the reason for this has to do with the cellulosic nature of cotton. Cellulose is known to contain a structure that features extensive hydrogen bonding. When aqueous solutions of high EO-containing nonionic surfactants are added to cellulose, the hydrogen bonds in the amorphous regions can break and form weak hydrogen bonding interactions with the added water molecules. The reduced number of intra-cellulose hydrogen bonding interactions brought about by the additional water molecules is perceived as a reduction in wrinkling of the cellulosic material. The added water can thus introduce a perceptible wrinkle-relaxing effect on the material.

In addition to the foregoing, Applicants speculate that there is yet another explanation for the increased wrinkle-relaxation that is imparted to cellulosic fibers by the cleaning compositions of the present invention. During heat treatment, Applicants speculate that there is a slow uptake by the garments of the aqueous EO-containing surfactant systems described and claimed herein. As the alcohol ethoxylates are rather hydrophilic by nature, once heat treatment ceases and a garment is used, worn or stored, the hydrophilicity of the now-entrained alcohol ethoxylate molecules can cause the cellulosic fibers of the garment to associate with additional ambient water molecules that may be present. As a result, the amount of wrinkling of a given cellulosic garment may actually be perceived to *decrease* over time, as with wearing. This phenomenon has been borne out by studies under variable

humidity conditions. It was found that garments that were heat treated with high-EO surfactant systems according to the present invention in lower humidity environments tended to become more wrinkled over time, while those that were used in higher humidity environments actually exhibited *less* wrinkling with time.

Further suitable nonionic surfactants which may be used with the heat-activated cleaning compositions of the present invention include polyoxyethylene carboxylic acid esters, fatty acid glycerol esters, fatty acid and ethoxylated fatty acid alkanolamides, certain block copolymers of propylene oxide and ethylene oxide, and block polymers of propylene oxide and ethylene oxide with propoxylated ethylene diamines. Also included are such semi-polar nonionic surfactants such as amine oxides, phosphine oxides, sulfoxides and their ethoxylated derivatives.

These thickened compositions, when heated above their phase transition temperatures, form surfactant solutions, emulsions, admixtures and the like, which readily flow as long as the system temperature remains above the phase transition temperature. In their flowable state, the solutions are readily transported from the substrate article to the garment, where they can effect cleaning. Preferred phase transition temperatures are between 30° C to 95° C, more preferably between 40° C to 85° C, and most preferably between 50° C to 70° C.

Another preferred surfactant system according to the present invention envisions surfactant blends that comprise amphoteric surfactants used either alone, or in combination with at least one anionic surfactant. As would be understood by those knowledgeable in the relevant art, certain surfactants known as zwitterionic surfactants are included among the class of substances known as amphoteric surfactants, and will not be discussed further. Amphoteric surfactants which contain an anionic water-solubilizing group, a cationic group or a hydrophobic organic group are suitable for use with the present invention, and may include amine oxides, amino carboxylic acids and their salts, amino dicarboxylic acids and their salts, alkyl-betaines, alkyl aminopropylbetaines, sulfobetaines, alkyl imidazolinium derivatives, certain quaternary ammonium compounds, certain quaternary phosphonium



compounds and certain tertiary sulfonium compounds. In some instances, certain amine oxide surfactants may be available in highly concentrated form, and thus contain nominal amounts of water. These and other nearly 100% active surfactants may also be referred to as "high active" surfactants and are included among the descriptions of nonionic, amphoteric or anionic surfactants as claimed and described herein. As will be understood by those knowledgeable in the relevant art, the term high active surfactant as used herein refers to those surfactants that can be used as received from the manufacturer, without requiring the addition of supplemental water to bring about thickening of the surfactant. The total amount of amphoteric surfactant or amphoteric plus anionic surfactant that may be used in accordance with the teaching of the present invention is greater than about 10% of the total self-thickening surfactant system. That is, there may be about 10-100% of a surfactant blend used in the heat-activated cleaning compositions of the present invention. In the case of any mixed surfactant system, i.e., one that contains a nonionic surfactant combined with an amphoteric surfactant and any optional anionic surfactants, the total contribution of all surfactants to the heat-activated cleaning composition of the present invention will comprise 10-100% of the total weight of the cleaning composition.

Anionic surfactants which may be used as part of the surfactant system of the present invention include ammonium, substituted ammonium (e.g., mono-, di-, and triethanolammonium), alkali metal and alkaline earth metal salts of C<sub>6-20</sub> fatty acids and rosin acids, linear and branched alkyl benzene sulfonates, alkylethoxylated ether sulfates, propoxylated ether sulfates, alkyl sulfates, alkyl ether sulfates, alkane sulfonates, alpha olefin sulfonates, hydroxyalkane sulfonates, fatty acid monoglyceride sulfates, alkyl glyceryl ether sulfates, acyl sarcosinates and acyl N-methyltaurides, as well as any combination of the foregoing. Alkali metal carboxylates are also envisioned. Also regarded among the class of anionic surfactants for purposes of the present invention are certain sulfonated hydrotropes. Sulfonated hydrotropes which may be used in conjunction with the surfactant systems of the present invention include: sodium xylene sulfonate; sodium cumene sulfonate; sodium toluene sulfonate. An example of one surfactant system according to the teaching of the present invention that comprises an amphoteric surfactant in combination with an anionic surfactant is an amine oxide with a linear alkylbenzene sulfonate. Another example of a

surfactant system of the present invention that is comprised of an amphoteric surfactant and an anionic surfactant is cetyldimethyl betaine and sodium xylene sulfonate. Both of these foregoing combinations gives rise to thickened surfactant systems at ambient temperature, that can be transferred from a substrate article to a fabric at slightly elevated temperatures. It is understood that these two surfactant systems are included here as examples only, and in no way limit the utility or combinations of surfactant blends that might be contemplated, and also fall within the description of the present invention.

As stated above, the surfactant blends contemplated for use herein can exhibit high viscosity at ambient temperature, and yet flow readily at elevated temperatures. In this flowable condition, the solutions readily transport from the substrate article to the garment, where they can effect cleaning or fabric refreshing. Preferred phase transition temperatures are between 30° C and 95° C, more preferably between 40° C to 85° C, and most preferably between 50° C and 70° C.

Also possible for use as the self-thickening surfactant system of the present invention are single or multiple surfactants which have melting points at ambient temperatures. These systems, while envisioned for this application, are not preferred unless they are able to provide viscous cleaning compositions which become more fluid at temperatures above ambient temperatures. Certain surfactants that have melting points at ambient temperatures may also happen to be high active surfactants. As defined above, the term high active surfactant is used herein to refer to those surfactants that can be used as received from the manufacturer, without requiring the addition of supplemental water to bring about thickening of the surfactant.

#### ADJUNCTS

In addition to surfactants, the cleaning and refreshing compositions of the present invention can also incorporate common cleaning and performance adjuncts such as solvents and fragrances, as well as minor amounts of bleaching agents, brighteners, chelating agents or sequestrants, enzymes, etc.

Solvents envisioned include glycol ethers, available under such tradenames as Cellosolve<sup>®</sup>, Arcosolve<sup>®</sup>, and Carbitol<sup>®</sup> (for example Methyl Carbitol, Butyl Carbitol, and Propyl Carbitol), as well as methoxy propoxy propanol, ethoxy propoxy propanol, butoxy propoxy propanol, propoxy propoxy propanol, and the like, and mixtures thereof. Also envisioned are lower alcohols, glycols, and polyols, as well as terpenes and hydrocarbon solvents such as Isopar K<sup>®</sup> or Isopar M<sup>®</sup>.

Bleaching agents envisioned for use with the self-thickening heat-activated cleaning compositions include peroxide or active oxygen sources selected from the alkaline earth metal salts of percarbonate, perborate, persilicate and hydrogen peroxide adducts and hydrogen peroxide. Most preferred are sodium percarbonate, sodium perborate mono- and tetrahydrate, and hydrogen peroxide. Other peroxygen sources may be possible, such as monopersulfates and monoperphosphates, or their equivalent aqueous forms, such as monopersulfuric acid, known in the trade as Caro's acid or Caroate, a product of BASF AG, Germany. Bleaching activators and catalysts are also envisioned.

Brighteners or fluorescent whitening agents, such as stilbene, styrene and styrylnaphthalene brighteners may also be included. Such brighteners are commercial available from such suppliers as Ciba Chemicals and Bayer Chemicals.

Fragrances which are useful for aesthetic purposes are also commercially available, and may be desirable for use with the self-thickening heat-activated cleaning and refreshing compositions of the present invention. Suppliers of fragrances include such companies as Norda, International Flavors and Fragrances (IFF), and Firmenich.

Chelating agents or sequestrants can be included with the inventive cleaning compositions discussed herein, preferably as non-phosphate containing sequestrants, and most preferably as an aminopolyphosphonate. These chelating agents assist in maintaining the stability of any activators and active oxygen sources which may be present in order to achieve optimum performance. In this manner, they act to chelate heavy metal ions, which cause catalyzed decomposition of the active oxygen source, although this is a non-binding

theory of their action and not limiting. These agents also can effect cleaning by chelating metal ions which can be found in soils.

If desirable, the chelating agent is selected from a number of known agents which are effective at chelating heavy metal ions. The chelating agent should be resistant to hydrolysis and rapid oxidation by oxidants. Preferably, it should have an acid dissociation constant (pKa) of about 1-9, indicating that it dissociates at low pHs to enhance binding to metal cations. Acceptable amounts of the optional chelating agent range from 0-1,000 ppm, more preferably 5-500 ppm, most preferably 10-100 ppm chelating agent self-thickening cleaning composition.

The most preferred chelating agent is an aminopolyposphonate, which is commercially available under the trademark Dequest from Monsanto Company. Examples thereof are Dequest 2000, 2041, and 2060. (See also Bossu, U.S. Patent No. 4,473,507, column 12, line 63 through column 13, line 22, incorporated herein by reference.) A polyphosphonate, such as Dequest 2010, is also suitable for use.

Other preferred non-phosphate containing chelating agents, such as ethylenediamine-tetraacetic acid (EDTA) and nitrilotriacetic acid (NTA) may also be suitable for use. Still other new, preferred chelating agents are new propylenediaminetetraacetates, such as Hampshire 1,3 PDTA, from W.R. Grace, and Chel DTPA 100#F, from Ciba Geigy A.G. Mixtures of the foregoing may be suitable.

Additional desirable adjuncts that may be suitable for use with the self-thickening heat-activated cleaning and refreshing compositions of the present invention include enzymes, although it may be preferred to also include an enzyme stabilizer. Proteases are one especially preferred class of enzymes. They are preferably selected from alkaline proteases. The term "alkaline," refers to the pH at which the enzymes' activity is optimal. Alkaline proteases are available from a wide variety of sources, and are typically produced from various microorganism (e.g., *Bacillus subtilis*). Typical examples of alkaline proteases include Maxatase and Maxacal from Genencor; Alcalase, Savinase, and Esperase

are available from Novo Nordisk A/S. See also Stanislawski, *et al.*, U.S. Patent No. 4,511,490, incorporated herein by reference. Further suitable enzymes are amylases, which are carbohydrate-hydrolyzing enzymes. It is also preferred to include mixtures of amylases and proteases. Suitable amylases include Rapidase from Societé Rapidase; Milezyme from 5 Miles Laboratory; and Maxamyl from Genencor.

Still other suitable enzymes are cellulases, such as those described in Tai, U.S. Patent 4,479,881, Murata *et al.*, U.S. Patent 4,443,355, Barbesgaard *et al.*, U.S. Patent 4,435,307, and Ohya *et al.*, U.S. Patent 3,983,082, incorporated herein by reference. Yet other suitable 10 enzymes are lipases, such as those described in Silver, U.S. Patent 3,950,277, and Thom *et al.*, U.S. Patent 4,707,291, incorporated herein by reference.

The hydrolytic enzyme should be present in an amount of about 0.01-5%, more preferably about 0.01-3%, and most preferably about 0.1-2% by weight of the composition. 15 Mixtures of any of the foregoing hydrolases are desirable, especially protease/amylase blends.

Additional adjuncts can also include, but are not limited to, dye transfer inhibitors, fabric softeners, antistatic agents, antiredeposition agents, soil release agents, anti-wrinkle 20 agents, antimicrobial agents, pesticides such as acaricides, sizing and shrinkage control agents.

### SUBSTRATE ARTICLES

The substrate articles which may be suitable for use with the self-thickening heat- 25 activated cleaning and refreshing compositions of the present invention will now be described more fully. The substrate articles, which provide a vehicle or carrier for delivering the cleaning or refreshing compositions, may be porous or non-woven sheets. The substrate articles may be formed from any fibrous or cellular flexible material which exhibits sufficient thermal stability for use in the dryer or when exposed to heat, sufficient chemical 30 stability when exposed to even the most concentrated surfactant system, and which can retain sufficient amounts of the self-thickening cleaning composition to effectively clean or

refreshen fabrics without significant leaking or bleeding of the composition during storage. Such sheets include sheets of woven and nonwoven synthetic and natural fibers, felt, paper, or foam, such as hydrophilic polyurethane foam.

5 Preferably, conventional sheets of non-woven materials are used as substrates herein. Non-wovens are generally defined as adhesively bonded fibrous products having a web or corded fiber structure, or those which comprise fibrous mats in which the fibers are distributed haphazardly or in a random array. The fibers can be natural, such as wool, silk, jute, hemp, cotton, linen, sisal, or ramie; or synthetic such as rayon, cellulose ester, polyvinyl  
10 derivatives, polyolefins, polyamides or polyesters. Generally, any diameter or denier of fiber is useful in the present invention. The non-woven cloth substrates employed herein are not prone to tear or separate when used, for example, in an automatic dryer, due to the haphazard or random array of fibers in the non-woven material which impart excellent strength in all directions.

15 Preferred substrates for use in the dry-cleaning sheets of this invention have dimensions ranging from about 3" x 4" (approx. 7.6 cm x 10.2 cm) up to about 14" x 16" (35.6 cm x 40.6 cm). However, the substrate must also be of a sufficient size to carry a desirable load of solvent-based dry-cleaning composition. For these reasons, the most  
20 preferred size of substrates for use in the present invention range from about 4" x 14" (10.2 cm x 35.6 cm), particularly from about 5" x 12" (12.7 cm x 30.5 cm) to about 9" x 10" (22.9 cm x 25.4 cm).

During heat treatment, the cleaning compositions of the present invention are  
25 preferably given up slowly from the substrate article or other vehicle or carrier with which the cleaning compositions are introduced to garments or fabrics to be cleaned and/or refreshed. In any event, "fast" or "slow" are relative terms used in conjunction with the speed with which the cleaning compositions may be released, it is to be understood that the phrase "slow release" or "given up slowly" as used herein refers to a process that takes  
30 greater than about 5 minutes, more preferably greater than about 7.5 minutes, and most preferably one that takes greater than about 10 minutes in the case of an in-home rotary type

clothes dryer. It is to be understood that even where other heating devices may exhibit somewhat faster heating times, however, the heat-activated surfactant systems of the present would nonetheless likely require longer dispersion or distribution times than comparative cleaning compositions of the prior art.

5

Applicants speculate, without being bound by theory, that there are several possible mechanisms by which the garments or fabrics may be cleaned and or refreshed by the cleaning compositions of the present invention, either or both of which may help to explain the cleaning that is observed. The first cleaning mechanism involves the ability of the active  
10 surfactant (or surfactants) to provide a cleaning function by solubilizing a spot or stain. As the surfactant moves across or into the fibers of a fabric or garment, it may dilute the spot or stain or spread it out over a wider area. The result is that the fabric may seem "cleaner" as the spot or stain region may appear as if it has been reduced in intensity. Alternately, some or all of the spot-causing foreign matter may be solubilized by the surfactant system and  
15 brought to the surface of the fabric or garment, such that subsequent agitation during tumbling or through use or wear causes the surfactant-solubilized stain or spotting material to be dislodged and fall away from the fabric. Second, it is also conceivable that the small amount of water which may be introduced to the fabric or garment along with the surfactant system is sufficient to help lift the spot or stain from the targeted object being cleaned once  
20 the spot or stain has been solubilized by the surfactant system. Third, the small quantities of water that may be present, albeit very small as in the case of "high active" surfactants, can aid in removing malodors from garments or fabrics being treated. It is known that water is useful in helping to remove malodor impression, and it can therefore be useful for refreshing garments or fabrics according to the present invention. Lastly, it is also recognized that the  
25 optional incorporation of a fragrance would help impart a freshening function, for example, by modifying the odor of stale, musty, or sour-smelling fabrics or textiles.

#### CLOSABLE BAG

The flexible container or closable bag which may be suitable for use with the self-  
30 thickening heat-activated cleaning compositions of the present invention will now be described more fully. In order to effectively contain any vaporous components of the dry-

cleaning compositions to within the confines of the sealed or closable bag, the bag must, of course, be fabricated of an essentially gas impermeable material and comprise an opening which can be reversibly closed, yet at the same time permit the venting of excess vapor. For example, the bag can be formed from polyethylene, polypropylene, polyamide or a multi-ply or layer complex comprising such materials. It is also important that the containment bag not be substantially damaged upon exposure to high dryer temperatures and/or highly concentrated surfactant systems. It has been estimated that household dryers tend to heat unevenly, for instance, and that various regions within the dryer may experience temperatures up to about 120° C (about 248° F) and even up to about 150° C (about 302° F), with surfaces of the dryer reaching temperatures as high as about 200° C (392° F). Several factors may account for these higher dryer temperatures, such as clogged lint filters, poor dryer venting, temperature control malfunctions, poor heat dissipation ability, or a combination of these factors.

Furthermore, it is additionally understood that any flexible container or closeable bag that is suitable for use in according to the present invention will be one that is able to withstand contact with the cleaning compositions of the present invention. In other words, certain of the surfactant systems according to the present invention, used either alone or in combination, may involve higher total surfactant concentrations than have heretofore been used in conjunction with home dry-cleaning kits of the prior art. Thus, flexible containers or closures that are known in the prior art may not necessarily be suitable for use with the cleaning systems of the present invention.

### **EXPERIMENTAL SECTION**

The compositions of the present invention as described above and illustrated through several examples included in the following Experimental Section. The examples which are provided herein are intended for illustrative purposes only, and in no way limit or restrict the embodiments appropriate for use with the self-thickening heat-activated cleaning compositions of the present invention.

#### **EXAMPLE 1**



Example 1 illustrates the preparation of an aqueous self-thickening surfactant system comprising a nonionic surfactant according to the foregoing discussion. For the preparation of the surfactant system, 20.48 g of the nonionic surfactant Neodol 25-7 (7 mole ethoxylate of a C<sub>12-15</sub> alcohol) was heated to about 50° C and added to 28.80 g deionized water, and stirred until the mixture was homogeneous. Next, 5.0 g of the resulting mixture, which contained approximately 42% nonionic surfactant, was applied to a 9" x 10" (22.9 cm x 25.4 cm) piece of a dry-laid nonwoven cellulosic material, and spread evenly over the surface. As the aqueous solution cooled on the cellulosic material, the mixture became increasingly thick or gel-like. The resulting cellulosic-padded cleaning article had a good hand feel without exhibiting stickiness or mess. The use of this cleaning article is described more fully below. Alternately, the aqueous composition could first be cooled after mixing, and thereafter applied to the substrate article or cellulosic material. In this instance, the cleaning composition would be applied in such a manner as to uniformly distribute the cleaning composition, such as with a scrim or doctor bar.

Upon heating the foregoing cellulosic-padded cleaning article for a short period of time in a dryer inside a dryer bag, it was observed that the composition had once again become substantially less viscous, as the cleaning article freely gave up the liquified composition. Evidence was found in the dryer bag that the cleaning composition had been transferred from the cleaning article to the walls of the dryer bag.

## EXAMPLE 2

The following example, Example 2, illustrates the use of a surfactant blend, comprising an amphoteric surfactant in combination with one or more anionic surfactants, to effect a cleaning composition according to the foregoing discussion. Accordingly, 4.04 g of an amine oxide surfactant, Barlox 12 (C<sub>12</sub>-dimethylamine oxide from Lonza, 30% active) and 3.01 g of an anionic surfactant, Biosoft 40S (the sodium salt of dodecylbenzenesulfonic acid from Stepan, 40% active) were blended to produce a highly viscous mixture. An additional 17.07 g deionized water was added with stirring to produce a ringing gel comprising about 10% active matter. The mixture could be heated to produce a flowable mixture for easy application and spreading onto a nonwoven cellulosic substrate, or applied to the nonwoven

substrate with a scrim or doctor bar when cooled.

A cleaning article produced with the above surfactant blend also exhibited good hand feel (good hand), without seepage or leaching during storage.

### EXAMPLE 3

Addition of a like amount of amine oxide and dodecylbenzenesulfonic acid (LAS) as was used in Example 2 was added to 24.69 g deionized water, resulting in a 7.5% active aqueous solution of the dual surfactant blend. This mixture rendered a solution of relatively low viscosity which remained flowable even at ambient temperatures. When applied to a nonwoven cellulosic substrate, the mixture resulted in significant seepage of the cleaning composition. This example is therefore *not* a preferred embodiment according to the present invention, but is included to provide an example illustrative of compositions that are similar to the prior art.

As may be seen from Example 2 above, a surfactant mixture containing about 10% active matter—and thus 90% water—is an example of an embodiment that is consistent with the teaching of the present invention. Compositions that contain 7.5% actives, and thus 92.5% water—as shown in Example 3 above—are therefore *not* preferred for use with the present invention.

### EXAMPLE 4

Example 4 illustrates the use of a single high active[s] surfactant to effect a self-thickening cleaning composition according to the foregoing discussion. Here, 5.0 g hexadecyldimethylamine oxide (Barlox® 16S from Lonza; 30% active) was applied in a heated, low viscous state onto a nonwoven cellulosic substrate. Upon cooling, the cleaning article was easy to handle and exhibited neither seepage nor leakage of the cleaning composition during storage. In this Example, note that the hexadecyldimethylamine oxide was employed as-received from the manufacturer; i.e., without use of additional water.

In addition to the examples provided under Examples 1-4 above, note that it is also

possible to optionally add a fragrance to any of the inventive self-thickening heat-activated cleaning compositions already described, in accordance with the teaching of the present invention. Such compositions would also impart freshening characteristics to the garments and fabrics so treated.

**Table I**

Surfactant and Water Content of Examples 1-4

Example			
	<u>No.</u>	<u>Surfactant System</u>	<u>Water</u>
10	1	42% nonionic (100% active)	58%
	2	17% amine oxide (30% active), or 5% active amine oxide and 12% anionic surfactant (40% active), or 5% active anionic	90%
15	3 <sup>a</sup>	13% amine oxide (30% active), or 4% active amine oxide, and 9% anionic surfactant (40% active), or 4% active anionic	92.5%
	4	100% amine oxide (30% active), or 30% active amine oxide	70%

Note to Table I

<sup>a</sup>Example 3 is *not* preferred for use according to the teaching of the present invention due to the observed seepage of the cleaning composition described above. Data from Example 3 is therefore included in Table I for comparison purposes.

Above Examples 1, 2 and 4 show that different types of surfactants and different weight percents of those surfactants may be used to achieve heat-activated cleaning compositions according to the teaching of the present invention. Further in accordance with the teaching of the present invention, and for the reasons previously described, it has therefore been found desirable to have less than about 92.5% water in the surfactant blend comprising the cleaning compositions of the present invention, more preferably less than about 91% water, and most preferably less than about 90% water in the surfactant blend comprising the cleaning compositions of the present invention.

The results of a series of experiments to evaluate the EO content of alcohol ethoxylates and the surprising effect they have on the wrinkle-tendency of garments treated with inventive cleaning compositions of the present invention will now be described.

#### Example 5

In Example 5, a sequence of experiments were conducted in order to determine the effect of concentration, chain length (i.e., hydrophobic portion of the ethoxylated alcohol) and number of ethylene oxide (EO) units per molecule for various ethoxylated alcohols as compared to neat water. The ethoxylated alcohols that were used evaluated included molecules having 20, 30, 40, 55 and 70 EO units per molecule of alcohol. All of the foregoing were obtained from Union Carbide Corporation as approximately 100% active surfactants, among which the 20, 30 and 40 EO-containing alcohol ethoxylates are commercially available under the Tergitol® name.

To mimic the effect of higher loading due to prolonged exposure to a treated substrate at elevated temperature, or due to repeated exposure to substrates at elevated temperatures, solutions of high-EO surfactants were prepared and sprayed onto fabrics. A quantity of alcohol ethoxylate was mixed with the appropriate quantity of water to generate 1 wt. %, 5 wt. % and 10 wt. % active surfactant mixtures for at least one of each of the above five secondary ethoxylates, respectively. Some of the cleaning compositions, especially those at higher EO-content, required the application of slight heating in order to facilitate processing of the surfactant with the additional water. The garments were simply sprayed with the aqueous cleaning compositions at ambient temperature, rather than applying the cleaning compositions during heat treatment, as would normally be experienced, for example, in a rotary dryer. At least one 100% cotton and one 50% cotton/50% polyester blend material were used as the target garments for each cleaning solution prepared.

After application of the cleaning composition to fabric samples and subsequent drying, the samples were intentionally crushed vigorously to imitate severe wear conditions. After varying lengths of time (from 12-48 hours) the fabric samples were visually and

qualitatively evaluated for wrinkling and wrinkle resistance by each member of a panel of trained individuals. Overall, it was found that by increasing the EO content of the alcohol ethoxylate from 30 to 55 and even as high as 70 EO-units per molecule of ethoxylate, better wrinkle resistance was imparted to the treated garment. Similarly, it was found that as the concentration of the surfactant system increased from 1% by weight to 5 % by weight, the garments exhibited increasingly more favorable behavior against wrinkling over time. Results achieved by the various cleaning compositions based on the quantity of ethoxylate groups per molecule of alcohol, from most favorable to least favorable, may be represented according to:

$$70 \text{ EO} > 55 \text{ EO} \approx 40 \text{ EO} > 30 \text{ EO} \approx 20 \text{ EO}$$

Thus, it may be seen that use of the lower EO-containing alcohol ethoxylates is least favorable and that the higher the EO-content, as well as the higher the percentage of active surfactants, the more favorable the wrinkle resistance imparted to the garments. Similar results are experienced after repeated exposure of fabrics or garments to high-EO surfactants in a rotary clothes-type dryer application. Such treated fabrics also show less wrinkling directly after removal from the dryer.

Example 5 above reveals that there appears to be a discernable correlation between active concentration and ethylene oxide content of nonionic surfactant systems according to the present invention, and the extent to which a garment or fabric so treated may evince increasing resistance to wrinkle formation over time. It may therefore be postulated, within the confines of reasonable speculation, that cleaning compositions comprised of surfactant systems that contain even more than 70 ethylene oxide units per molecule of alcohol ethoxylate could likewise exhibit an even greater reduction in the tendency to wrinkle.

It will be understood that various other changes of the details, steps, arrangements of components and uses which have been herein described and illustrated in order to explain the nature of the invention will occur to and may be made by those skilled in the art upon a reading of this disclosure, and such changes are intended to be included within the principle

and scope of this invention. The invention is further defined without limitation of scope or of equivalents by the claims which follow.

What is claimed is:

1. A solventless, heat-activated cleaning composition for a fabric-cleaning article, comprising:

a self-thickening surfactant system selected from among:

a) at least one nonionic surfactant:

b) a surfactant blend further comprising an amphoteric surfactant optionally combined with one or more anionic surfactants; and

c) combinations of any of the foregoing; and

optionally, water;

wherein the self-thickening surfactant systems are solid or highly viscous at room temperature.

2. The solventless, heat-activated cleaning composition of Claim 1, wherein viscosity is above about 500 centipoise at ambient temperature.

3. The solventless, heat-activated cleaning composition of Claim 1, wherein the viscosity is above about 1,000 centipoise at ambient temperature.

4. The solventless, heat-activated cleaning composition of Claim 1, wherein the viscosity is above about 2,000 centipoise at ambient temperature.

5. The solventless, heat-activated cleaning composition of Claim 1, wherein: the nonionic surfactant is selected from among:

linear ethoxylated alcohols with an average chain length of 6 to 18 carbon atoms (C6-18) and averaging about 2 to 20 moles of ethylene oxide (2-20 EO) per mole of alcohol;

linear and branched, primary and secondary ethoxylated, propoxylated alcohols with an average length of about 6 to 18 carbon atoms and averaging 0-10 moles of ethylene oxide and about 1 to 10 moles of propylene oxide per mole of alcohol;

linear and branched alkylphenoxy or polyethoxy alcohols or ethoxylated alkylphenols, with an average chain length of 8 to 18 carbon atoms and

averaging 1.5 to 30 moles of ethylene oxide per mole of alcohol;  
high ethylene oxide-containing ethoxylated alcohols with an average chain length of  
about 6 to 18 carbon atoms C(6 to 18) and averaging above 30 moles of  
ethylene oxide per mole of alcohol;  
5 high ethylene oxide-containing linear and branched, primary and secondary  
ethoxylated, propoxylated alcohols with an average chain length of about 6 to  
18 carbon atoms and averaging above 30 moles of ethylene oxide per mole of  
alcohol;  
polyoxyethylene carboxylic acid esters and fatty acid glycerol esters;  
10 fatty acid and ethoxylated fatty acid alkanolamides;  
block copolymers of propylene oxide and ethylene oxide;  
block polymers of propylene oxide and ethylene oxide with propoxylated ethylene  
diamines;  
amine and phosphine oxides;  
15 sulfoxides and their ethoxylated derivatives;  
as well as combinations of any of the foregoing;  
the amphoteric surfactant is selected from among:  
amine oxides;  
amino carboxylic acids and their salts;  
20 amino dicarboxylic acids and their salts;  
alkyl-betaines;  
alkyl aminopropylbetaines;  
sulfobetaines;  
alkyl imidazolinium derivatives;  
25 quaternary ammonium, phosphonium and tertiary sulfonium compounds;  
as well as combinations of any of the foregoing; and  
the anionic surfactant is selected from among:  
ammonium, mono-, di- and tri-ethanol substituted ammonium, alkali metal and  
alkaline earth metal salts of C<sub>6-20</sub> fatty acids and rosin acids;  
30 linear and branched alkyl benzene sulfonates;  
alkylethoxylated and propoxylated ether sulfates;



alkyl, alkyl ether, alkyl glyceryl ether, and fatty acid monoglyceride sulfates;  
alkane, alpha olefin and hydroxyalkane sulfonates;  
acyl sarcosinates;  
acyl N-methyltaurides;  
5 alkali metal carboxylates;  
sodium xylene, sodium cumene and sodium toluene sulfonates;  
as well as combinations of any of the foregoing.

6. The solventless, heat-activated cleaning composition of Claim 1, wherein the self-  
10 thickening surfactant system comprises about 10-100% of the total weight of the cleaning  
composition.
7. The solventless, heat-activated cleaning composition of Claim 1, further wherein the  
cleaning composition exhibits a phase transition temperature between about 30° C to 95° C.
- 15 8. The solventless, heat-activated cleaning composition of Claim 1, further wherein the  
cleaning composition exhibits a phase transition temperature between about 40° C to 85° C.
9. The solventless, heat-activated cleaning composition of Claim 1, further wherein the  
20 cleaning composition exhibits a phase transition temperature between about 50° C to 70° C.
10. The solventless, heat-activated cleaning composition of Claim 5, wherein the  
nonionic surfactant is selected from among:  
high ethylene oxide-containing ethoxylated alcohols with an average chain length of  
25 about 6 to 18 carbon atoms C(6 to 18) and averaging above 30 moles of  
ethylene oxide per mole of alcohol;  
high ethylene oxide-containing linear and branched, primary and secondary  
ethoxylated, propoxylated alcohols with an average chain length of about 6 to  
18 carbon atoms and averaging above 30 moles of ethylene oxide per mole of  
30 alcohol;  
as well as combinations of the foregoing.

11. The solventless, heat-activated cleaning composition of Claim 1, further wherein the nonionic surfactant imparts a wrinkle-resistance to the treated garment or fabric.

5 12. The solventless, heat-activated cleaning composition of Claim 10, further wherein the nonionic surfactant imparts a wrinkle-resistance to the treated garment or fabric.

13. A solventless, heat-activated cleaning composition for use in home dry-cleaning, comprising:

10 a self-thickening surfactant system selected from among:

a) at least one nonionic surfactant:

b) a surfactant blend further comprising an amphoteric surfactant optionally combined with one or more anionic surfactants; and

c) combinations of any of the foregoing; and

15 optionally, water.

14. A heat-activated fabric-cleaning article comprising a porous substrate sheet stably impregnated with a solventless cleaning composition comprising:

a self-thickening surfactant system selected from among:

20 a) at least one nonionic surfactant;

b) a surfactant blend further comprising an amphoteric surfactant optionally combined with one or more anionic surfactants; and

c) combinations of any of the foregoing; and

optionally, water.

25 wherein the cleaning composition has a viscosity greater than about 500 centipoise at ambient temperatures.

15. A method for cleaning fabrics, comprising contacting a fabric or garment with a solventless, heat-activated cleaning composition, comprising:

30 a self-thickening surfactant system selected from among:

a) at least one nonionic surfactant:

- b) a surfactant blend further comprising an amphoteric surfactant optionally combined with one or more anionic surfactants; and
- c) combinations of any of the foregoing; and

optionally, water;

wherein the self-thickening surfactant systems are solid or highly viscous at room temperature.

16. The method for cleaning fabrics of Claim 15, wherein viscosity is above about 500 centipoise at ambient temperature.

17. The method for cleaning fabrics of Claim 15, wherein the viscosity is above about 1,000 centipoise at ambient temperature.

18. The method for cleaning fabrics of Claim 15, wherein the viscosity is above about 2,000 centipoise at ambient temperature.

19. A method for cleaning fabrics, comprising:

agitating said fabrics with an article comprising an integral substrate having releasably contained or having releasably affixed thereto a heat-activated cleaning composition comprising:

a self-thickening surfactant system selected from among:

a) at least one nonionic surfactant;

b) a surfactant blend further comprising an amphoteric surfactant optionally combined with one or more anionic surfactants; and

c) combinations of any of the foregoing; and

optionally, water;

wherein the self-thickening surfactant systems are solid or highly viscous at room temperature.

20. A cleaning and refreshing process for fabrics, comprising:

contacting said fabrics with an effective amount of a heat-activated cleaning

composition, so that the fabrics are cleaned and refreshed, wherein the composition comprises

a self-thickening surfactant system selected from among:

a) at least one nonionic surfactant:

b) a surfactant blend further comprising an amphoteric surfactant optionally combined with one or more anionic surfactants; and

c) combinations of any of the foregoing; and

optionally, water;

wherein the self-thickening surfactant systems are solid or highly viscous at room temperature.

## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/US00/08257
**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : C11D 1/66, 1/825, 1/83, 3/37

US CL : 510/506, 519, 520; 134/42; 8/116.1

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 510/506, 519, 520; 134/42; 8/116.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,632,396 A (PEREZ-ZAMORA et al.) 04 January 1972, column 3, lines 1-47, column 6, lines 67-73, column 10, line 70-column 11, line 11, column 16, lines 1-17.	1-20
X	US 5,041,230 A (BORCHER, SR. et al.) 20 August 1991, column 3, lines 34-62, column 4, lines 34-47.	1-20

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

09 MAY 2000

Date of mailing of the international search report

07 JUL 2000

 Name and mailing address of the ISA/US  
 Commissioner of Patents and Trademarks  
 Box PCT  
 Washington, D.C. 20231

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# INTERNATIONAL SEARCH REPORT

Form PCT/ISA/210 (continuation of first sheet(1)) (July 1998)

International application No.

PCT/US00/08257

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐

The additional search fees were accompanied by the applicant's protest.

☒

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/08257

**BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING**

This ISA found multiple inventions as follows:

Group I, claim(s) 1-13, drawn to a surfactant composition.

Group II, claim(s) 14, drawn to an article containing a surfactant.

Group III, claim(s) 15-20; drawn to a method of using a surfactant composition.

The inventions listed as Groups I-III do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The groups do not share a common structural feature, as the surfactant of claim 1, for example, may be any nonionic surfactant. Furthermore, Group I does not make a contribution over the prior art, as claim 1 reads on simple nonionic surfactants, which are very well known in the surfactant art.